ROLE OF SOUND RISK AND COST-BENEFIT ANALYSIS

IN IMPROVING TRANSPORTATION SAFETY

STATEMENT OF

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INTRODUCTION

Good morning, Chairwoman Kelly, Chairman Bartlett, and Honorable Committee members. My name is Dr. Aviva Brecher, and I am a senior technology and policy analyst at the Department of Transportation's John A. Volpe National Transportation Systems Center in Cambridge, Massachusetts. At the Volpe Center I have worked on a number of technical and regulatory support projects involving risk assessment, management and communication, such as: a hazard analysis of commercial space transportation, the safety of high speed rail and magnetic levitation systems, and health, safety and environmental impacts of electromagnetic fields and radiation.

Today, I am pleased to testify on the use of risk assessment and risk management (RA/RM) and of Cost-Benefit Analysis (CBA) methods in sound transportation safety regulations, and in developing technology-based options that may provide better alternatives to existing regulations.

THE JOHN A. VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER

The Volpe Center is a national center of technical knowledge and expertise on transportation issues, and is recognized for its systems analysis approach to

solving transportation problems. The Volpe Center provides technical, economic and operations management services to a broad range of federal clients through working agreements. Although the Center is a federal entity, it does not receive any direct Congressional appropriations -- all work is conducted for sponsor agencies on a cost reimbursable basis.

Our work focuses on specific complex topics and on cross-disciplinary and cross-modal efforts. Of about 500 employees, the Volpe Center has about 400 professional staff, with more than half holding advanced degrees in science, engineering, economics and operations research. Our knowledge base on transportation safety and special cross-modal synergy results from 27 years of diverse experience and close interactions with both public and private sector providers of transportation products and services.

Since the founding of the Volpe Center in 1970, we have been actively involved in safety programs for our clients: developing safety data bases, assessing risks, analyzing alternative technological and other means of reducing risk, developing risk communication and training modules, and determining the cost-effectiveness for risk management approaches.

TECHNOLOGY AND ANALYSIS TOOLS FOR AGENCY DECISIONMAKING

Most DOT regulatory Administrations, including the National Highway Traffic Safety Administration (NHTSA), The Federal Railroad Administration (FRA), the Federal Aviation Administration (FAA) and the U.S. Coast Guard (USCG), have routinely performed risk and cost-benefit analysis to support regulatory development of safety standards, safety training, and risk prevention programs. These analyses must be judiciously tailored to the specific safety, security, or environmental hazards being considered.

One area where the Volpe Center is particularly active is human performance in transportation. Human error and inappropriate human-machine interface design, as opposed to mechanical failure, are major causes of transportation accidents. Much research is devoted to understanding the strengths and limitations of "humans in the loop," the safety risks due to operator performance error or fatigue, and risk mitigation options that take advantage of human capabilities and compensate for limitations. The Volpe Center is actively engaged in a strategic interagency partnership initiative on "Human-Centered Transportation" to enhance transportation safety and to assist aging drivers, system operators, and others through improved system interface design and the optimization of information displays and operating procedures.

The Volpe Center also is involved in risk management. Effective risk management requires the definition of technical and operational options for reducing either the frequency (probability) or the severity (consequence) of the risky events. Cost-Benefit Analyses are performed to identify and compare risk reduction benefits of risk management options, versus their cost, and to understand other risk-versus-risk trade-offs.

Risk management can be an important alternative to traditional regulatory approaches. Within RSPA, the Office of Pipeline Safety is demonstrating risk management as a means for regulating the natural gas and hazardous liquid pipeline industries. Through this approach, pipeline companies will propose alternatives to existing federal regulations. Based upon a risk analysis, including input from the public and other stakeholders, these alternatives will replace underlying regulations if they provide a superior level of safety and environmental protection. The demonstration will provide pipeline companies with potential cost savings and flexibility to determine the best means to ensure safety. At the same time, they will provide the public with enhanced protection from the risk of pipeline failure.

Development and application of advanced technologies, taking full account of human behavioral and performance characteristics throughout system design and operation, are at the heart of further safety improvements. Our experience shows that, by providing improved understanding of a problem and developing

innovative technologies or other information or knowledge-based approaches, agencies enhance their ability to make important safety decisions. In some cases, these decisions may be reached through rulemaking. In other cases, technology may provide significant safety benefits as alternatives to current regulations. In either case, however, enhanced information and technology are valuable tools for more effective agency regulatory decisionmaking.

The following are some recent examples of Volpe Center activities, conducted on behalf of Department of Transportation sponsors, that demonstrate the benefits of technology in improving transportation safety and agency decisionmaking.

Gage Restraint Measurement System (GRMS): As an example of technology aids to risk prioritization and management, the Volpe Center worked cooperatively over the past several years to design, develop, test and deploy an advanced railroad track integrity survey system, the Gage Restraint Measurement System (GRMS). This instrument package mounted on a moving railcar has benefited track inspectors and enhanced operations safety, by enabling the automated detection and characterization of rail tie condition. The GRMS has led to more efficient and cost-effective maintenance prioritization and planning. At present, the equipment manufacturers have built and marketed several similar systems based on the Volpe Center GRMS design, while the rail

industry has purchased and implemented automated inspection programs using this instrumentation.

Intelligent Transportation Systems for Automotive Collision Avoidance: This example illustrates how risk analysis can guide development of technology to reduce the highest sources of risk, and enhance safety by assisting the driver, vehicle performance, or traffic flow management. On behalf of NHTSA's Office of Crash Avoidance Research, the Volpe Center analyzed various crashes and Intelligent Transportation Systems (ITS) countermeasure actions. The goal was to identify promising opportunities for the application of advanced technologies to improve the crash avoidance capabilities of the driver-vehicle system. Based on this analysis, a series of programs were initiated by NHTSA to move the collision avoidance concepts to system prototypes, and to begin proof-of-concept demonstrations and evaluations of safety benefits. In addition, the results of this study were recently used to estimate the preliminary benefits of collision avoidance systems by a NHTSA Benefits Working Group.

FRA Corridor Risk Model-- A Volpe Center study for the FRA is developing a risk modeling and assessment tool capable of assessing the potential risk reduction benefits associated with advanced train control systems. The analytical model under development at Volpe Center uses the FRA's Geographic Information System as a platform to prioritize train corridors by risk level. It considers the historical crash data in light of track geometry, topography, existing

freight and passenger traffic density, and population density along the corridor to determine the risk reduction impact of higher levels of Positive Train Separation and control. Application of this risk exposure algorithm will allow risk-based prioritization of rail corridors on which higher levels of train control would yield greatest safety benefits.

Establishment of the Relative Risk of Alcohol in Recreational Boating Fatalities-- While it was widely believed that alcohol intoxication was associated with many boating fatalities, there were no quantitative estimates of the relative risk of fatality as a function of intoxication. At the request of Congress, the Coast Guard's Office of Navigation Safety and Water Ways Services decided to study and quantify the risk in this area. Based on exacting fatality surveys and extensive field exposure studies, the Volpe team determined that risk of a fatal boating accident was about 10 times greater for a boater with a blood alcohol concentration of 0.1% than for a sober boater.

This work supported the use of alcohol testing by Coast Guard, state, and local boating enforcement agents. The impact of the federal documentation of a tenfold increase in fatalities for intoxicated recreational boaters was to strengthen law enforcement activities and increase the likelihood of convictions of individuals who are arrested for boating while intoxicated. The methodology followed a model successfully used by NHTSA, which established the risk of alcohol-related fatality and used the increased risk estimates to energize law enforcement and judicial processes for public safety.

Understanding and Reducing General Aviation Collision Risks--Volpe Center conducted for the FAA a statistical analysis of General Aviation (GA) accidents to investigate possible risk factors related to controlled flight into terrain (CFIT) crashes. This study used the National Transportation Safety Board (NTSB) database of 31,790 aviation crashes which occurred between 1983 and 1994. Analyses of this database provided insight into factors that are related to CFIT type GA accidents in the NTSB aviation accident database (86.7% of which were general aviation accidents). The findings will guide further analyses and help design experiments with electronic moving maps to study what and how information needs to be displayed to improve pilots' understanding of, and ability to avoid terrain.

Transit Bus and Passenger Accident Prevention Guidance-- This is an example or risk identification, ranking and preparation of risk communications and training tools to enhance transit safety. For the FTA, the Volpe Center conducted comprehensive audits of transit systems' operational safety and crashes or incidents, and identified generic safety hazards using a System Safety approach. Based on accident analysis and risk data, a System Safety Program Plan Guidance document was prepared. It shows how to develop and implement a crash prevention program for urban, rural and specialized transit systems. It includes personnel and training issues, evaluation of design options for new vehicles, promotion of safety awareness for riders, and policies and procedures. Sample inspection, maintenance, and generic hazards checklists are included to assist public and private transit operators reduce crash risks through prevention.

Training workshops were conducted by Volpe Center staff for transit operators in cooperation with the American Public Transit Association and with the New York City Transit Authority.

Emergency Response Notification System: The Emergency Response Notification System (ERNS) has been jointly maintained and funded by EPA and RSPA since 1987. The ERNS system is the national repository of all initial notifications of hazardous substance and oil spills reported to the National Response Center and the EPA regions. It helps identify and assess the probabilities, consequences and locations of transportation hazardous materials and oil releases, and helps local and State authorities respond promptly and efficiently. The data is made available to the public and other government agencies, on request. It is also available on EPA's Internet site. This is an example of an information-based risk assessment tool.

Conclusion

The need for technical sophistication in all aspects of assessing and mitigating risk and evaluating associated costs and benefits offers a significant opportunity to national technical facilities, such as the Volpe Center. The federal government experts in Risk Assessment can assist the business community–especially smaller business–by making them knowledgeable about the risks that concern them, and the means by which they can respond. Dissemination of published reports through the NTIS and the World Wide Web, Technology Transfer and frequent outreach and training programs are now used. Organizations participating in the Federal

Laboratories Consortium and in other Technology Transfer networks represent an enormously valuable resource in identifying, ranking, and dealing with the unintended risks that arise in the use of technology, and in applying technology to reduce risks.

BRIEF RESUME OF DR. AVIVA BRECHER

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1987- : Senior staff in Transportation Strategic Planning and Analysis Office at Research and Special Administration's Volpe Center. Manager of Radiation Safety work for FAA; Member of High Speed Ground Transportation Safety Analysis and regulations development team, Manager of Electric and Magnetic Fields (EMF) Research Program (FRA). Work topics included:environmental, health and safety issues related to power frequency EMF and radiofrequency radiation (NHTSA, FRA, OST); radiation safety and protection (FAA); maglev and high speed rail safety analysis and development of safety regulations (FRA); EMF measurements in rail, transit and other transportation systems (FRA, DOE); superconducting magnet safety and EMF mitigation (FRA); strategic transportation research, advanced technologies, innovation and technology transfer and partnering issues for outreach and policy support (RSPA, OST); defense conversion opportunities in transportation; advanced materials R&D for infrastructure renewal and vehicles (RSPA); technologies to measure environmental impacts of transportation; commercial space launch risk assessment and orbital safety for licensing safety and insurability, technology commercialization and industry analysis for DOT Office of Commercial Space Transportation; assessment of future air traffic control environment; threat/operations analysis and system optimization for air drug interdiction (US Customs); future requirements of global air traffic control (USAF).

1986-87: Consultant in Science and Technology Policy, Education Policy and Business Development. Prepared a study of technical higher education in MA, and participated in space technology projects for A.D. Little, Inc. (climate monitoring satellites, solar and nuclear powered spacecraft, commercialization of space).

1985-86: Director of Academic-Corporate Relations at Boston University. Initiated and conducted corporate outreach and technical exchanges with industry to support faculty and research centers.

1980-85: Senior Staff Consultant in Safety and Engineering Technology at Arthur D. Little, Inc. Led and contributed to projects for government agencies and private industry on: risk assessments for nuclear waste disposal, environmental radiation standards, geotechnical risk and mining safety, space technology and commerce, and space-based solar power generation and climate change detection and characterization.

1983-84: Congressional Science Fellow for the American Physical Society. Worked with Senator Paul Tsongas (D-MA) on space, energy, defense, and science/technology policy issues (with Small Business, Foreign Relations, and Energy and Env. Comm.)

1979: Japan Society for Promotion of Science Fellow at the University of Tokyo and the Polar Science Research Institute on the magnetism of antarctic meteorites and implications for their origin and evolution.

1977-80: Assistant Professor of Physics, Wellesley College and Physics Lecturer and Visiting Scientist at M.I.T. Taught undergraduate physics, applied math and lab courses.

1972-77: Research Associate, Earth and Planetary Sciences, M.I.T. P.I. in NASA Lunar and Planetary Exploration Program; established Laboratory for Paleomagnetism, conducted research, supervised BS and

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